Position feedback system for volume holographic storage media

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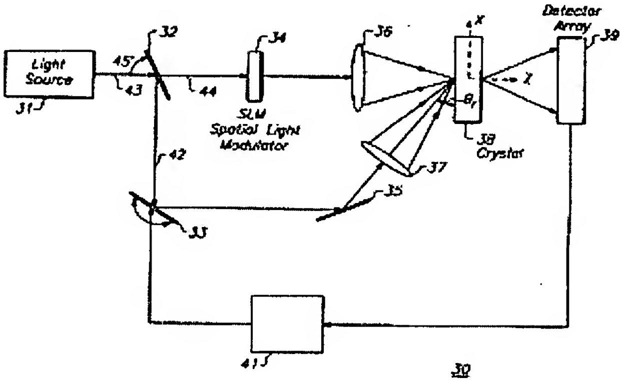
A method of holographic recording in a photorefractive medium wherein stored holograms may be retrieved with maximum signal-to noise ratio (SNR) is disclosed. A plurality of servo blocks containing position feedback information is recorded in the crystal and made non-erasable by heating the crystal. The servo blocks are recorded at specific increments, either angular or frequency, depending whether wavelength or angular multiplexing is applied, and each servo block is defined by one of five patterns. Data pages are then recorded at positions or wavelengths enabling each data page to be subsequently reconstructed with servo patterns which provide position feedback information. The method of recording data pages and servo blocks is consistent with conventional practices. In addition, the recording system also includes components (e.g. voice coil motor) which respond to position feedback information and adjust the angular position of the reference angle of a reference beam to maximize SNR by reducing crosstalk, thereby improving storage capacity.



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CLAIMS

[Claim(s)]
1. It is the approach of performing holographic recording to a refractility medium. Step which records two or more servo blocks in the image space in a medium How to perform holographic recording to the refractility medium containing the step which records two or more data pages in the image space in a medium.
2. Generate Each Servo Block by Giving Position Feedback Information, and Irradiating Medium with Servo Block Reference Beam and Servo Block Body Beam, and Producing Migration of Charge in Medium. It is the approach according to claim 1 carry out incidence of each servo block reference beam and the servo block body beam to the field of a medium at a servo block reference include angle, and a servo block reference include angle specifies the include angle of Hazama of a servo block reference beam and a servo block body beam.
3. Each Data Page is Prescribed by Interference Grid Generated by Irradiating Medium with Data Page Reference Beam and Data Page Body Beam, and Producing Migration of Charge in Medium. It is the approach according to claim 1 carry out incidence of each data page reference beam and the data page body beam to the field of a medium at a data page reference include angle, and a data page reference include angle specifies the include angle of Hazama of a data page reference beam and a data page body beam.
4. Approach according to claim 1 of containing further step which changes two or more servo blocks into two or more permanent holograms which are not eliminable with exposure of medium which follows.
5. The step which changes two or more servo blocks is an approach containing the step which heats a medium further according to claim 4.
6. A servo block is a method according to claim 1 of giving the means for reconfigurating one of the data pages without the cross talk from other data pages substantially.
7. Each servo block is a method according to claim 1 of being located in the periphery of the image space in a medium.
8. A servo block body beam and a servo block reference beam are an approach according to claim 2 generated in the coherent monochromatic light source.
9. A data page body beam and a data page reference beam are an approach according to claim 3 generated in the coherent monochromatic light source.
10. Each servo block reference include angle is an approach according to claim 2 are separated only from about 1/2 of the minimum angle spacing of a medium of an approach.
11. Each data page reference include angle is an approach according to claim 3 are separated only from the minimum angle spacing of a medium of an approach.
12. Each identifier is a method according to claim 1 of giving the means for distinguishing each image space, including further the step of two or more image space of a medium which records an image space identifier inside respectively.
13. The approach according to claim 12 of containing further the step which changes an image space identifier into the permanent hologram which is not eliminable with the exposure of a consecutive medium.
14. It is Approach of Performing Holographic Recording to Refractility Medium. Step Which Records 1st Servo Block on Medium is Included. It generates by the 1st servo block being prescribed by the 1st interference grid, and the 1st grid's irradiating a medium with the 1st reference beam and the 1st body beam, and producing migration of the charge in a medium. Incidence of the 1st servo block reference beam and the 1st servo block body beam is carried out to the field of a medium at the 1st servo block reference include angle. The 1st servo block reference include angle specifies the include angle of Hazama of the 1st servo block reference beam and the 1st servo block body beam. The approach of holographic recording is . The

step recorded through the 2nd servo block is included. It generates by the 2nd servo block being prescribed by the 2nd interference grid, and the 2nd grid's irradiating a medium with the body beam of 2nd reference beam **** 2nd, and producing migration of the charge in a medium. Incidence of the 2nd servo block reference beam and the 2nd servo block body beam is carried out to the field of a medium at the 2nd servo block reference include angle. The 2nd servo block reference include angle specifies the include angle of Hazama of the 2nd servo block reference beam and the 2nd servo block body beam. The approach of holographic recording is . The step recorded through the 3rd servo block is included. It generates by the 3rd servo block being prescribed by the 3rd interference grid, and the 3rd grid's irradiating a medium with the body beam of 3rd reference beam **** 3rd, and producing migration of the charge in a medium. Incidence of the 3rd servo block reference beam and the 3rd servo block body beam is carried out to the field of a medium at the 3rd servo block reference include angle. The 3rd servo block reference include angle specifies the include angle of Hazama of the 3rd servo block reference beam and the 3rd servo block body beam. The approach of holographic recording is . The step recorded through the 4th servo block is included. It generates by the 4th servo block being prescribed by the 4th interference grid, and the 4th grid's irradiating a medium with the 4th reference beam and the 4th body beam, and producing migration of the charge in a medium. Incidence of the 4th servo block reference beam and the 4th servo block body beam is carried out to the field of a medium at the 4th servo block reference include angle. The 4th servo block reference include angle specifies the include angle of Hazama of the 4th servo block reference beam and the 4th servo block body beam. The approach of holographic recording is . The step recorded through the 5th servo block is included. It generates by the 5th servo block being prescribed by the 1st interference grid, and the 5th servo block irradiating a medium with the 5th reference beam and the 5th body beam, and producing migration of the charge in a medium. Incidence of the 5th servo block reference beam and the 5th servo block body beam is carried out to the field of a medium at the 5th servo block reference include angle. The 5th servo block reference include angle specifies the include angle of Hazama of the 5th servo block reference beam and the 5th servo block body beam. The approach of holographic recording is . The step recorded through the 1st data page is included. The 1st data page is prescribed by the 1st data page interference grid. The 1st data page grid is generated by irradiating a medium with the 1st data page reference beam and the 1st data page body beam, and producing migration of the charge in a medium. Incidence of the 1st data page reference beam and the 1st data page body beam is carried out to the field of a medium at the 1st data page reference include angle. The 1st data page reference include angle specifies the include angle of Hazama of the 1st data page reference beam and the 1st data page body beam. The approach of holographic recording is . The step recorded through the 2nd data page is included. The 2nd data page is prescribed by the 2nd data page interference grid. The 2nd data page grid is generated by irradiating a medium with the 2nd data page reference beam and the 2nd data page body beam, and producing migration of the charge in a medium. Incidence of the 2nd data page reference beam and the 2nd data page body beam is carried out to the field of a medium at the 2nd data page reference include angle. The 2nd data page reference include angle specifies the include angle of Hazama of the 2nd data page reference beam and the 2nd data page body beam. The approach of holographic recording is . The step recorded through the 3rd data page is included. The 3rd data page is prescribed by the 3rd data page interference grid. The 3rd data page grid is generated by irradiating a medium with the 3rd data page reference beam and the 3rd data page body beam, and producing migration of the charge in a medium. Incidence of the 3rd data page reference beam and the 3rd data page body beam is carried out to the field of a medium at the 3rd data page reference include angle. The 3rd data page reference include angle is the method of performing holographic recording to a refractility medium of specifying the include angle of Hazama of the 3rd data page reference beam and the 3rd data page body beam.

15. The approach according to claim 14 of containing further the step which changes each servo block into the hologram which is not eliminable with a consecutive exposure.

16. The 2nd and 3rd servo blocks are the methods according to claim 14 of giving position feedback information during reconstruction of the 1st data page.

17. The 4th and 5th servo blocks are the methods according to claim 14 of giving position feedback information during reconstruction of the 2nd data page.

18. Each servo block is an approach according to claim 14 specified by one of five patterns.

Each of 19.5 patterns is an approach according to claim 18 recorded on around the periphery of image space.

Each of 20.5 patterns is an approach according to claim 18 specified by arrangement of five spots.

21. Each of a reference beam, a body beam, a data page reference beam, and a data page body beam is the

approach according to claim 14 of spreading on the same wavelength.
22. The adjoining data page is an approach according to claim 14 recorded at intervals of the angle of the minimum angle spacing of a crystal.
23. An adjoining servo block is an approach according to claim 14 recorded for the angle increment of about 1/2 of the minimum angle spacing.
24. It is Approach for Searching Hologram Recorded in Image Space in Refractility Medium. The step recorded in image space [/ through two or more servo blocks] is included. Each servo block It is prescribed by the interference grid generated by irradiating a medium with a servo block reference beam and a servo block body beam, and producing migration of the charge in a medium, including position feedback information. Incidence of each servo block reference beam and the servo block body beam is carried out to the field of a medium at a servo block reference include angle. A servo block reference include angle specifies the include angle of Hazama of a servo block reference beam and a servo block body beam. The approach for searching a hologram is . The step which changes each of two or more servo blocks into the eternal pattern of a refractive index in a medium which is not eliminable with a consecutive exposure, and which changes spatially, The step recorded in image space [/ through two or more data pages] is included. Each data page is prescribed by the interference grid generated by irradiating a medium with a data page reference beam and a data page body beam, and producing migration of the charge in a medium. Incidence of each data page reference beam and the data page body beam is carried out to the field of a medium at a data page reference include angle. The approach for a data page reference include angle specifying the include angle of Hazama of a data page reference beam and a data page body beam, and searching a hologram is . By making the field of a medium spread a data page reference beam at a reference include angle Step which reconfigurates one and position feedback information on a data page in a detector array Approach containing the step which answers position feedback information and adjusts a data page reference include angle for searching a hologram.
25. It is Approach of Performing Holographic Recording to Refractility Medium. Step Recorded in Image Space [/ through Two or More Servo Blocks] is Included. Each Servo Block It is prescribed by the interference grid generated by giving position feedback information, and irradiating a medium with a servo block reference beam and a servo block body beam, and producing migration of the charge in a medium. Carry out incidence of each servo block reference beam and the servo block body beam to the field of a medium, and they are specified by servo block reference wave length. The approach of holographic recording is . The step recorded in image space [/ through two or more data pages] is included. Each data page It is prescribed by the interference grid generated by irradiating a medium with a data page reference beam and a data page body beam, and producing migration of the charge in a medium. Each data page reference beam and a data page body beam are a method of performing holographic recording to a refractility medium which carries out incidence to the field of a medium, and is specified by data page reference wave length.
26. The servo block reference include angle specified by Hazama of each servo block reference beam and each servo block body beam is an approach according to claim 24 fixed.
27. The data page reference include angle specified by Hazama of each data page reference beam and each data page body beam is an approach according to claim 24 fixed.
28. It is Equipment for Searching Hologram Recorded with Position Feedback Information in Image Space in Refractility Medium. Means for Generating Beam of Light, The means for dividing the beam of light into a body beam and a reference beam, Space optical modulator for modulating body beam The optical means for leading the body beam and reference beam which carry out incidence to the field of a medium at the reference include angle between both beams, Detector array for changing lightwave signal into an electrical signal Equipment including the means for answering receipt position feedback information in position feedback information, and adjusting a reference include angle for searching a hologram.
29. It is Approach for Searching Hologram Recorded in Two or More Image Space Which Can be Set to Refractility Medium. The step which records two or more servo blocks in the image space in medium is included. Each servo block It is prescribed by the interference grid generated by irradiating a medium with a servo block reference beam and a servo block body beam, and producing migration of the charge in a medium, including position feedback information. Incidence of each servo block reference beam and the servo block body beam is carried out to the field of a medium at a servo block reference include angle. A servo block reference include angle specifies the include angle of Hazama of a servo block reference beam and a servo block body beam. The approach for searching a hologram is . The step which changes each of two or more servo blocks into the eternal pattern of a refractive index in a medium which is not eliminable

with a consecutive exposure, and which changes spatially, Each identifier gives the means for distinguishing each image space including the step of image space which records an image space identifier inside respectively. The approach for searching a hologram is . The step which records two or more data pages in the image space in a medium is included. Each data page is prescribed by the interference grid generated by irradiating a medium with a data page reference beam and a data page body beam, and producing migration of the charge in a medium. Incidence of each data page reference beam and the data page body beam is carried out to the field of a medium at a data page reference include angle. The approach for a data page reference include angle specifying the include angle of Hazama of a data page reference beam and a data page body beam, and searching a hologram is . By making the field of a medium spread a data page reference beam at a reference include angle Step which reconfigurates one and position feedback information on the data page from image space by the detector array Approach containing the step which answers position feedback information and adjusts a data page reference include angle for searching a hologram.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
Location feedback system for a volume holography storage Field of invention This invention relates to the field of a holography storage system and an approach. More specifically, this invention records data on the refractility medium of the format of the hologram containing the permanent hologram which has position feedback information, and relates to the approach for reconfigurating data from the medium of a parenthesis.

Background of invention Rear-spring-supporter examination is performed for years about the possibility of the volume holography storage in a refractility medium over large digital memory capacity, a high-speed-data transfer rate, and short access time. The expectation for the data memory capacity of the magnitude of TERABAITO, the transfer rate exceeding 1 G byte/s, and the random access time for less than 100 microseconds is approaching implementation by development of the ingredient and holography storage component of these days.

A refractility ingredient has the property of induction of the refractive index being carried out by light, and changing. Holography storage can be performed by making a refractility medium spread the light beam and reference beam which have an image, and recording them. With the optical interference pattern obtained as a result, a rear-spring-supporter space refractive index is modulated by the whole volume of a medium. In refractility media, such as LiNbO3 (lithium niobate), the grid of a space refractive index occurs according to the electro-optical effect as a result of the internal field generated by migration and capture of an optical-pumping electron. If it irradiates using the same beam as the reference beam which used the medium for generating a refractive index grating, this beam will be diffracted so that the wave front which has the original image may be reproduced.

In the typical holography storage system shown in drawing 1 , the coherent monochromatic beam on which it is projected from the light source 11 is divided into the body beam 24 and a reference beam 22 by the beam splitter 12. The body beam 24 is changed into a lightwave signal using the space optical modulator (SLM) 14. The body beam 24 and a reference beam 22 pass along cutback OPUTIKUSU 16 and 17, it converges on the refractility crystal 18, and they irradiate this crystal, and generate the interference pattern which is recorded in the form of a refractive index grating and which is distributed over the volume in a crystal 18, otherwise the thing known as a hologram. The recorded hologram is reproducible by picturizing the lightwave signal which irradiated the crystal 18 and diffracted it using the same reference beam 22 to the detector array 19 changed so that a lightwave signal may be returned to an electrical signal.

Each uses multiplexing of various formats, such as an angle and wavelength, and can write in and store two or more holograms corresponding to a data page in a crystal 18. If angle multiplexing is used, each hologram will be written in by the reference beam which carries out incidence at a different include angle. This include angle changes according to the physical geometry of a crystal, and an ingredient. Typically, include angles differ every in the size of an about 50micro radian. This include angle is changeable moving a crystal 18 mechanically, while keeping constant the include angle to the reference from a body, or by operating the include angle of a reference beam using cutback OPUTIKUSU 16 and 17, and changing the incident angle of the reference beam to a crystal. In wavelength multiplexing, a reference beam is fixed at a certain include angle, and each hologram is generated, while changing the wavelength of the light source over each data page.

A certain limit which checks the potential advantage of holographic recording is a property [that the recorded hologram is metastable (un-continuing indefinitely)]. Although a hologram is a target one by one, when being recorded on the volume of the same crystal generally called the "stack" of record with the same breadth spatially in time, the hologram recorded henceforth has the inclination to make the diffraction

efficiency of the hologram written in previously reduced in non-homogeneity. Therefore, a "write-in" process makes the reinforcement of the hologram recorded on many write-in cycles by the rear-spring-supporter point reduced selectively, and destroys the hologram of the neighborhood recorded before. Similarly, redistribution of the charge which constitutes the recorded hologram arise according to "read-out" process of exposing a certain field to the exposure of a reference beam. It has led to development of the technique for immobilization of a hologram with this more nearly permanent, and development. For example, it can be made eternal, as a crystal is heated for the hologram generated with an electron charge pattern and redistribution of the ion which offsets the space charge change in a crystal arise.
After that, it is cooled, and a crystal captures ion, forms a permanent ionic lattice, and is brought about in change of a refractive index.
Other limits which check potential application of holographic recording are cross talks under hologram retrieval which restrict the information density **** storage capacity of a crystal. The stored image or data page is reproducible independently from other pages of the stack of record for the Bragg selectivity of read-out. As mentioned above, it can search by irradiating a medium by the same reference wave length as having used for recording an image. However, although the image relevant to specific reference wave length is certainly reconfigurated by the Bragg selectivity at the highest effectiveness, the image in which others were stored may be reconfigurated by Bragg's mismatching with distortion at effectiveness lower than it. In order to avoid the cross talk of this format, the angle between holograms or wavelength separation must correspond to accuracy 0 of the sinc function relevant to Bragg's match condition. When having shifted from the ideal include angle, a signal-to-noise ratio (SNR) gets worse. Consequently, the degree of maximal solution image of an image or one of the storage capacity of a system will be reduced.
Many policies have tried to conquer a limit of this capacity. However, there is nothing that was made to make max SNR of the signal recorded by reduction of a cross talk and positioning of an exact include angle during data page retrieval using the closed-loop location feedback system. Furthermore, there are not permanent in the same record section and a thing using the closed-loop location feedback system which combined the metastable hologram. As mentioned above, although the method of performing holographic recording to the refractility medium which can give the location feedback system for making into max SNR of the signal recorded by decreasing a cross talk, and can be applied to both an angle and wavelength multiplexing is searched for, it is not yet obtained.
The outline and the object of invention The comprehensive object of this invention is offering the method of performing holographic recording to a refractility medium of conquering a limit and fault of the advanced technology.
Concretely, the object of this invention is offering the approach of performing holographic recording to a refractility medium equipped with the location feedback system which makes max SNR of the signal recorded by decreasing a cross talk.
Other objects of this invention are offering the approach of performing holographic recording to the refractility medium which a location feedback system's can apply to both angle multiplexing and wavelength multiplexing.
The objects of further others of this invention are permanent and offering the approach of performing holographic recording to a refractility medium equipped with a location feedback system by combining a metastable hologram.
If the principle of this invention is followed, by the holographic recording approach, two or more servo blocks will be recorded on refractility media, such as LiNbO3 crystal, the 1st. Each servo block is prescribed by five spot patterns. A servo block generates a crystal by irradiating simultaneously in a body and a reference beam to the same field of a crystal. The incident angle over the field of a crystal by the reference beam defines a reference include angle. A servo block can bring about the position feedback under reconstruction of the data page stored in the crystal, and can reconfigurate a data page by the greatest SNR. A servo block is further recorded for 1/2 of the reference include-angle increments of the minimum angle separation of a crystal defined with the physical dimension of a crystal. A servo block is made into elimination impossible by heating the well-known approach, for example, a crystal, to this contractor at a degree (fixed). Each of five spots is recorded on the space of the same image as a data page so that position feedback information can search with a data page during retrieval of a hologram.
A data page is the same mode as a degree, namely, a crystal is recorded on the same image space of a crystal by irradiating an image simultaneously using the body beam and reference beam which it has. A data page is recorded for the reference include-angle increment of the minimum angle spacing of a crystal. The position feedback information from a servo block is told to a reflector positioner called a voice coil motor during

retrieval of a data page. A positioner adjusts the include-angle-location of a reflecting mirror by revolution, tunes the reference include angle of a reference beam finely, and makes max SNR of the signal recorded by decreasing a cross talk.

Easy explanation of a drawing Drawing 1 is the schematic diagram of the typical holographic recording system by the advanced technology which used the refractility crystal.

Drawing 2 is drawing of the flow of the step for attaining the holographic recording approach of following this invention.

Drawing 3 shows an example with the servo block for offering the position feedback for the holographic recording approach of following the principle of this invention.

Drawing 4 a-4e shows five patterns of the servo block of drawing 3 according to the principle of this invention.

Drawing 5 is drawing showing the amplitude of a data page as a function of the angle of incidence of a reference beam.

Drawing 6 is drawing showing the amplitude of a servo block as a function of the angle of incidence of a reference beam.

Drawing 7 is drawing showing a difference of the location function of drawing 6 as a function of an incident angle.

Drawing 8 is drawing showing the positioning function by which linearization was carried out as a function of the incident angle of a reference beam.

Drawing 9 shows servo block sinc image reinforcement as a function of the include angle of the angle of incidence of a reference beam.

Drawing 10 is the schematic diagram of the holographic recording system for the record of a hologram according to this invention, and reconstruction.

Detailed explanation of a desirable example Drawing 2 shows flow drawing of the step for attaining the approach of holographic recording of following this invention. This step includes the thing 200 for which a servo block is recorded on the decision 100 of the minimum angle spacing of a crystal, and a crystal, the thing 300 for which a crystal is heated and a servo block is fixed, the thing 400 for which a crystal is cooled to a room temperature, the thing 500 for which a data page is recorded on a crystal, and the thing 600 for which the recorded data page is reconfigurated.

The 1st step 100 performed in advance of record of a certain hologram is determining the minimum angle spacing required setting separate holographic recording to a refractility crystal so that a cross talk may become min. The detail at the time of drawing the equality for determining the minimum angle spacing is common knowledge at this contractor. Specifically, the detail is discussed and explained in the reference [/ else / phone / (John H.Hong) / 34th volume (Optical Engineering) John / of No. 8 / H.] which is applied to this invention by citation and which was entitled "a volume holography memory system:technique and architecture (Volume holographic memory systems: techniques and architectures)". [of the optical engineering in August, 1995] The phone etc. has specified the minimum angle spacing theta by the following equality.

Theta=lambda costheta0-/nLsin (thetar+thetao) -- (1)

They are the angle of incidence of the reference beam about the wavelength of lambda= signal, the refractive index of n= crystal, the thickness of L= crystal, and the thetar= z-axis, and the angle of incidence of the body beam about the thetao= z-axis among a formula.

thetar is determined based on the geometry of cutback OPUTIKUSU and a crystal. If thetao=0 and thetar which are shown in drawing 4 apply equality (1) to the example which is about 33 degrees, equality (1) will deform into below.

theta=1.88 lambda/nL -- (2)

If the minimum angle spacing is determined, a servo block is recordable on this contractor in the conventional mode which is common knowledge. A servo block is recorded using the desirable holographic recording system 30 shown in drawing 10 . A system 30 By modulating the pivotable reflecting mirror 33 which has two degrees of freedom for changing the beam splitter 32 and reference include-angle thetar which divide the signal generation light source 31 and a signal 43 into the body beam 44 and a reference beam 42, a reflecting mirror 35, and the body beam 44 By the refractility crystal 38 for recording SLM34 for changing an electrical signal into a lightwave signal, reducing glass 36 and 37, and a hologram, the detector array 39, and the array 39 The voice coil motor (VCM) 41 for answering the detected position feedback information and rotating a reflecting mirror 33 is included. SLM34 has the 1.0 [about] "x0.8" observation field, and has given the pixel field of about 640x480 for modulating a body beam. What kind of thing of common knowledge to this contractor that has a 0.5 [about] "x0.4" observation field, and gives the pixel field of about 1134x486 and that is called a charge-coupled device (CCD) for example is sufficient as the detector array 39. A crystal 38 is a disk configuration in Fe-LiNbO3, and thickness and a diameter are about 2mm and 70mm.

According to the practice of the conventional holographic recording, each servo pattern is recorded on a crystal 38 by irradiating the body beam 44 which has a servo pattern with a reference beam 42, and forming an interference grid in a crystal 38 at a certain specific reference include angle.

In a certain desirable example, each servo block is prescribed to drawing 3 by five spot patterns shown by A, B, C, D, and E. five reinforcement of each spot and those combination show the angle location of a reference beam, and give position feedback information. As shown in the example of drawing 3 , five spots are located in the periphery of a data area, and the data area is expressed with drawing 3 as a neighborhood field of the symmetry. In this example, a spot makes max distance between the pairs of the spot which specifies each of five servo blocks like a graphic display, and it is arranged so that the amount of the data area which can be searched may be optimized. The servo block of drawing 3 is shown with the reference beam which has one free shaft of a x axis, is emphasized and is expressed with Ax, Bx, Cx, Dx, and Ex. Probably, the reference beam defined by the Y-axis is emphasized and shown by Ay, By, Cy, Dy, and Ey. If it is this contractor, he will understand that other deformation of five patterns can be used including the number of other arrangement, a spot location, and spots.

The servo block over one free shaft x axis is defined by five patterns, A-B, B-C, C-D, D-E, and E-A as shown in drawing 4 a-4e. Each pattern defines deformation of five spots. For example, pattern A-B is defined by the spots A and B which were able to attach the shadow, pattern B-C is defined by B and C which were able to attach the shadow, pattern C-D is defined by the spots C and D which had the shadow given, pattern D-E is defined by the spots D and E which had the shadow given, and pattern E-A is defined by the spots E and A which had the shadow given. The spot which gave the shadow expresses the reinforced image and the spot which does not give the shadow shows the image which is not reinforced. from [that each servo block pattern records a pattern 1 by -0.75theta] -- beginning -- a pattern 2 -0.25theta -- ** -- it is recorded on **** to say for the increment of 0.5theta. Each of the servo block shown in drawing 4 a-4e gives feedback information, and makes it possible to search each data page with the greatest SNR so that it may explain below in the inside of this description.

Drawing 6 expresses the sinc function of five spots (A, B, C, D, E) of a servo block with a graph as a function of incident angle, i.e., reference include angle, thetar. thus, when the reference beam is shown through the include-angle range, five reinforcement of each spot in each servo block changes, as shown in drawing 9 . As shown in drawing 9 , the band B1 of each length, B-2, etc. correspond to the reinforcement of each spot as a function of an incident angle. furthermore, each angle of incidence brings about the "snap shot dump" of a servo block, i.e., five relative intensity of each spot. For example, 0

According to the incident angle of 25theta, the reinforcement of Spot C is max and, probably, on the other hand, as for Spots B and D, the image with more small reinforcement is shown.

Like the metastable hologram of a certain others which are recorded on a refractility medium, if recorded on a crystal, the servo block will be eliminated by the exposure performed henceforth as time amount passes. In order to make it not become eliminable by subsequent exposures and "to fix" a servo block, a crystal 38 is heated according to the conventional approach shown at step 300. Typically, Fe-LiNbO3 crystal is heated by about 150 to 200 C, and the period and ion depending on the dimension of a crystal become migratory. Cooling of a crystal 38 removes a crystal from a heat source promptly, and is performed by carrying out air cooling to ambient temperature (shown by step 400). Generally it depends for a cooling rate on the thermal shock resistance of a crystal. The process "fixes" a metastable hologram is common knowledge at this contractor. However, I think that the holographic recording approach which combines a metastable hologram is eternally [the artificer of this invention] strange in this technical field in the same record section, and it is a thing used as one of the descriptions which distinguishes this invention.

In addition, while writing the servo block in the medium, a detector array is not unuseful as include-angle feedback mechanism. Because, in a medium, it is a certain criteria sign.

It is because there is no **. An include angle theta can be determined like a disk drive servo store using the high gaging system of accuracy the encoder of a beam guide, or by observing both a body and a reference beam by other approaches of some kind.

If it is this contractor, in addition to a servo block, an image space identifier is recorded in the same image space, and the further position feedback information can be brought about so that he may understand.

Each identifier is original and it makes it possible to distinguish each image space from other image space.

An identifier is recordable on a servo block or a data page, and coincidence with this description using the technique which described the servo block. Furthermore, an identifier is also fixable with this description using the conventional approach described previously.

As shown by step 500, it is recorded on the same image space of a crystal 38 in the same conventional mode as having described above about record of a servo block of a data page in a degree. In the desirable example, each data page is recorded for the increment of the reference include angle theta which starts in 0. Therefore, drawing 5 expresses the amplitude of three recorded data pages D1, D2, and D3 as a function of an angle of incidence. When drawing 5 and 6 are examined simultaneously, it turns out that the servo block spots B and C give the nominal position feedback information over the data page D1, and the servo block spots A and B give the nominal position feedback information over the data page D3 by the servo block spots D and E giving the nominal position feedback information over the data page D2. For example, Spots B and C are normalization power called about 0.8, and are reinforced equally, Spots A and D are normalization power called about 0.1, and are reinforced equally, and this is expressed in theta= 0 by servo pattern B-C of drawing 4 b. The relation of an adjoining servo pattern is shown best at drawing 7 which shows a difference of a positioning function as a function of an incident angle. Function A-B expresses the difference in the sinc function of the servo blocks A and B, and function B-C expresses a difference of the sinc function of the servo blocks B and C, and continues similarly hereafter.

As shown in drawing 7 and 8, some positioning functions exist in the reference include angle each "data page core", i.e., a data page, indicates the highest reinforcement to be.

However, the linearity positioning function based on [each] data pages will give the most reliable position feedback information over the data page. Drawing 8 expresses the positioning function by which linearization was carried out as a function of the incident angle theta. Therefore, at Hazama of -0.25theta and 0.25theta, the feedback information over the data page 1 is given, the servo patterns 4 and 5 give the position feedback to the data page 2 in Hazama of 0.75theta and 1.25theta, and the servo patterns 2 and 3 are ****** similarly hereafter. By using the part to which linearization of each positioning function was carried out, this invention makes it possible to pursue a data page in an exact mode. In addition, in this example, the range of the positioning function by which the servo block was recorded for the increment of 0.5theta, consequently linearization was carried out is set to 0.5theta. If it is this contractor, he will understand that a servo block can be recorded for other increments and a data page can be searched with the still in addition greatest SNR. However, the range of the positioning function with which linearization of the increment was carried out under by 0.5theta decreases in number (refer to drawing 8). Furthermore, if an increment exceeds 0.5theta, although this range increases, it will contain a nonlinear part.

Reference include-angle thetar has two degrees of freedom. That is, thetar must point out what can be shown in x directions and the direction of y corresponding to a different hologram of in the image space where each increment in each direction is the same. Therefore, as this description described previously, the servo block pattern corresponding to the reference include angle shown in the direction of y is recordable along the vertical edge around the image space shown in drawing 3 . If the minimum angle spacing theta is determined, a write-in process will be started and the sequence which writes in a servo block will not receive constraint. The servo block with which the important description adjoins here is that are exposed at the almost same effectiveness and spacing is vacated for accuracy for the increment of 0.5theta.

As a certain improving point over the system 10 shown in drawing 1 , SNR of the recorded signal is made into max by this invention by taking in the above-mentioned position feedback information, tuning a reference include angle finely, and decreasing a cross talk.

In case a data page is reconfigurated, (it being shown in step 600) and a reference beam irradiate a crystal at a certain specific reference include angle. It is dependent on a reference include angle, and the partial image and servo pattern of a data page are generated in the detector array 39. For example, if a crystal is made to spread a reference beam by incident angle 0.75theta, the feedback information of the format of the partial image of the data page recorded by the reference include angle 0 and theta (shown in drawing 5) which show a cross talk, and the servo patterns 3, 4, and 5 (shown in drawing 6) will be reconfigurated. if drawing 8 is followed -- the positioning function 3-4 or either of 4-5 -- using -- the data pages D1 or D2 -- each can be searched. If position feedback information is transmitted to a voice coil motor (VCM) 41, VCM will rotate a reflecting mirror 33 and will adjust a reference include angle. If the reconfigurated data page reaches the maximum diffraction efficiency and reinforcement as a result, SNR will become max and a cross talk will become min. As the substitute, the reference beam which irradiates a crystal by angle-of-incidence 1.0theta reconfigurates the data page D2 with greatest SNR and the greatest, minimum cross talk (shown in drawing 5), and reconfigurates the servo patterns 1, 3, 4, and 5. Probably the same reinforcement is shown

and, as for the servo patterns 1 and 3, the servo patterns 4 and 5 also show the same reinforcement, as shown in drawing 9 .
He will understand that other means are applicable, in order to answer position feedback information and to adjust the incident angle of a reference beam again, if it is this contractor. For example, a crystal is rotated by the voice coil motor or the stepper motor, and an incident angle can be adjusted.
If the principle of this invention is followed, a servo block is also applicable to wavelength multiplexing. This application is the same as that of what described angle multiplexing previously. If the minimum wavelength spacing is determined, a servo block will be recorded at omega/2 of spacing, and, specifically, a data page will be recorded at intervals of omega. The detail about what the minimum wavelength spacing is determined for is common knowledge at this contractor. For example, by the reference besides a phone entitled "a volume holography memory system:technique and architecture", it is indicating making the minimum frequency spacing into the following.
[2pideltav/(c/n)] (1+costhetar)
They are v= optical frequency, a thetar= reference include angle, and the refractive index of n= crystal among a formula. Furthermore, a separate servo block must be recorded to each type of multiplexing, i.e., an include angle, and wavelength multiplexing. Independently, it can combine and the both sides of an angle and wavelength multiplexing can use.
Many deformation and modification will become clear easily by considering the above-mentioned explanation about a desirable example, without deviating from the pneuma of this invention to have the range more concretely shown to this contractor by the following claims. It does not only pass over the explanation and disclosure in this description to instantiation, and they should not be interpreted as what restricts the range of this invention more concretely shown by the following claims.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

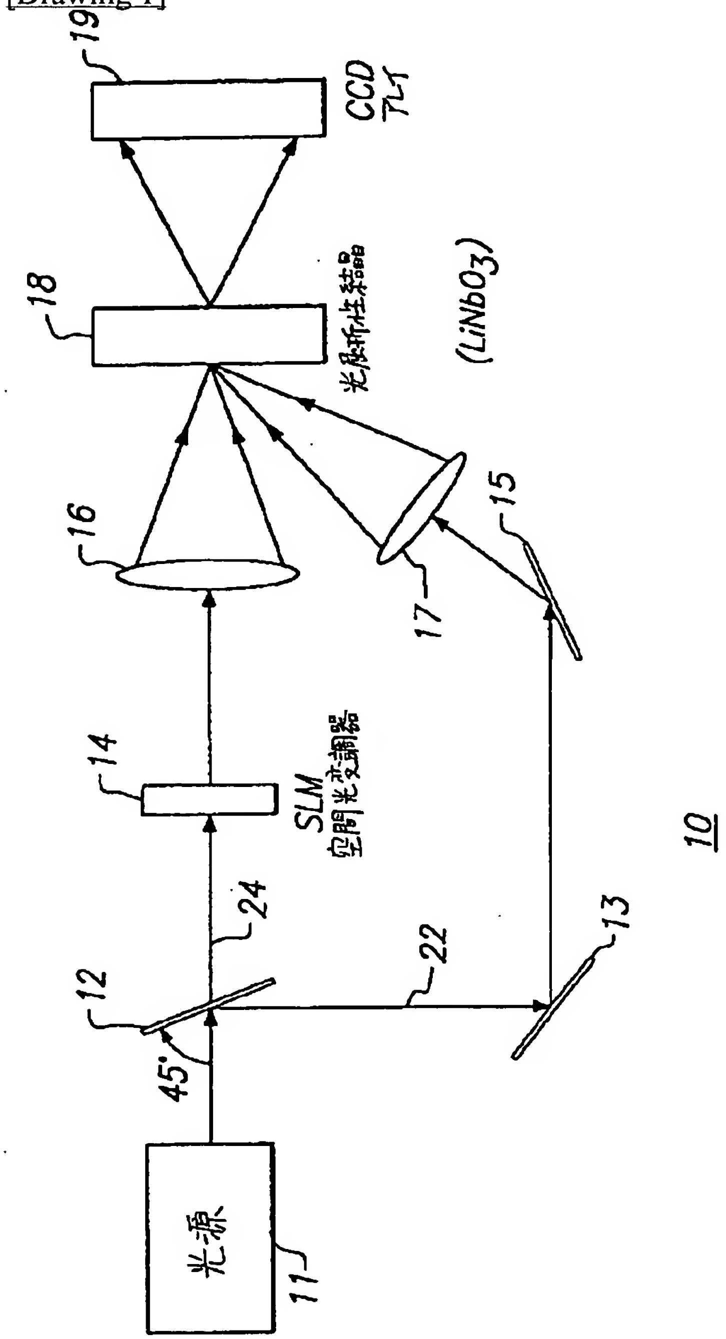
19
CCD アレイ
18
光屈折性結晶
(LiNbO3)
16
17
15
14
SLM 空間光変調器
24
12
22
13
45°
10
光源
11

FIG. 1
PRIOR ART

[Drawing 2]

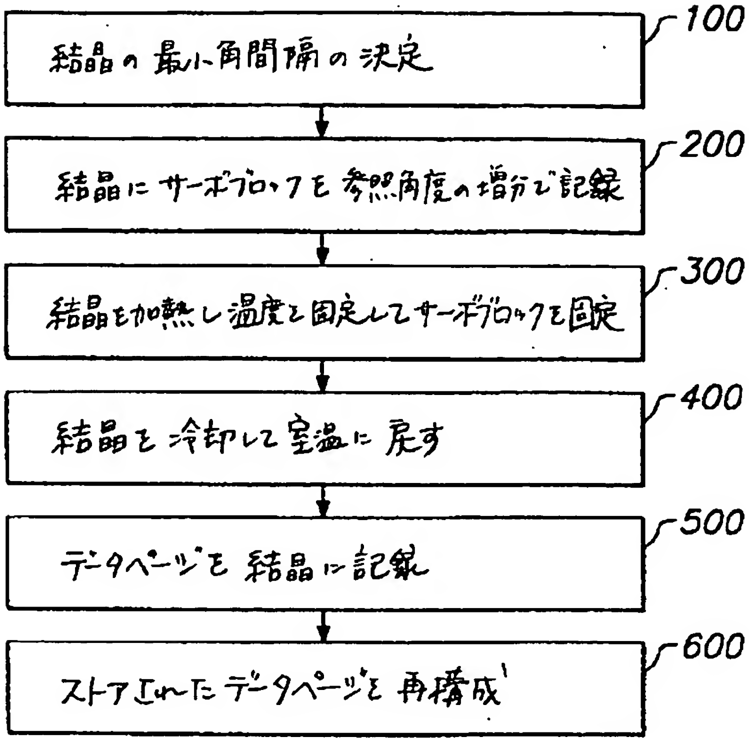
結晶の最小角間隔の決定
100
結晶にサーボブロックを参照角度の増分で記録
200
結晶を加熱し温度を固定してサーボブロックを固定
300
結晶を冷却して室温に戻す
400
データページを結晶に記録
500
ストアされたデータページを再構成
600

FIG. 2

[Drawing 3]

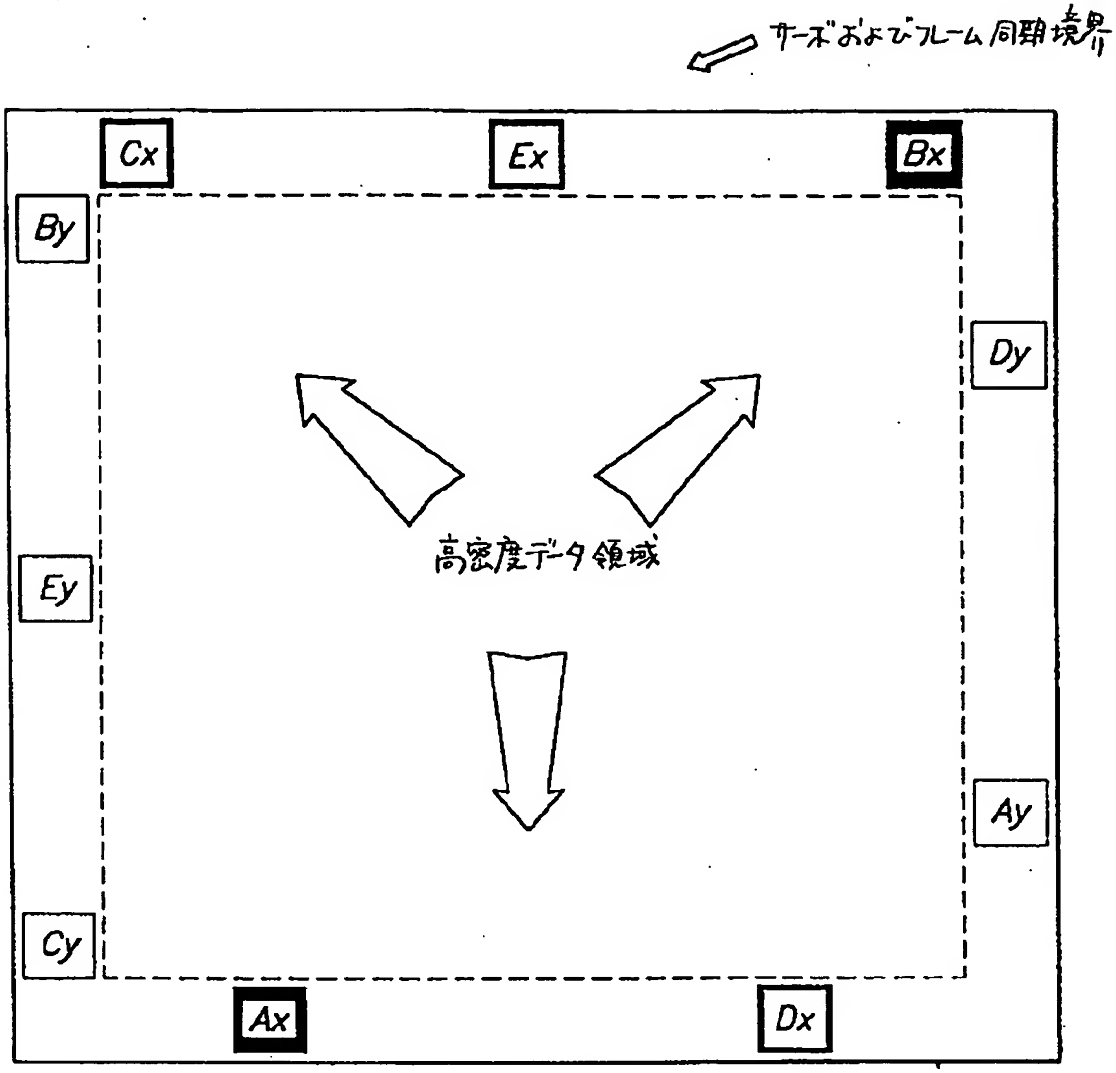
サーボおよびフレーム同期境界
Cx
Ex
Bx
By
Dy
高密度データ領域
Ey
Ay
Cy
Ax
Dx

FIG. 3

[Drawing 4]

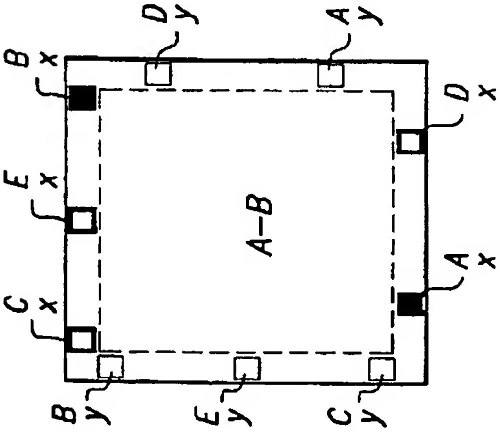
B x
E x
C x
D y
A y
D x
A x
A–B
B y
E y
C y

FIG. 4a

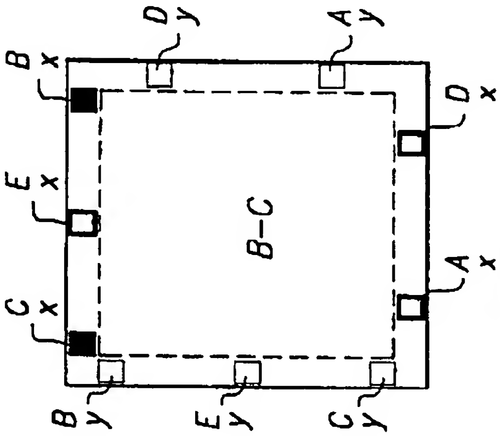
B x
E x
C x
D y
A y
D x
A x
B–C
B y
E y
C y

FIG. 4b

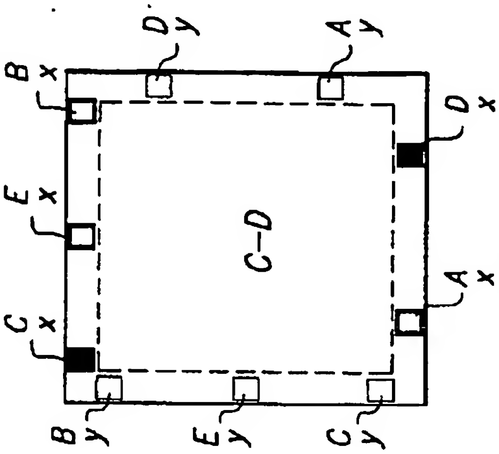
B x
E x
C x
D y
A y
D x
A x
C–D
B y
E y
C y

FIG. 4c

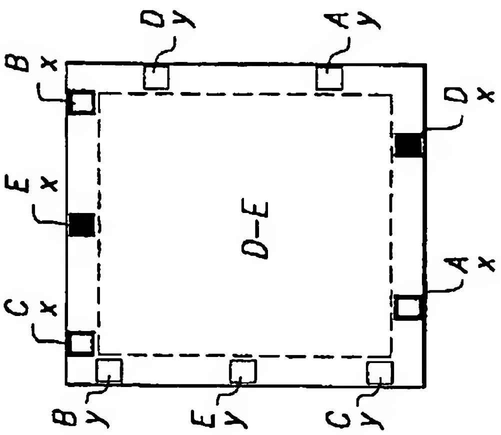
B x
E x
C x
D y
A y
D x
A x
D–E
B y
E y
C y

FIG. 4d

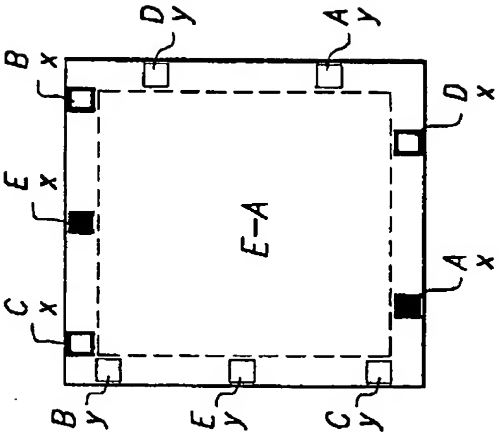
B x
E x
C x
D y
A y
D x
A x
E–A
B y
E y
C y

FIG. 4e

[Drawing 5]

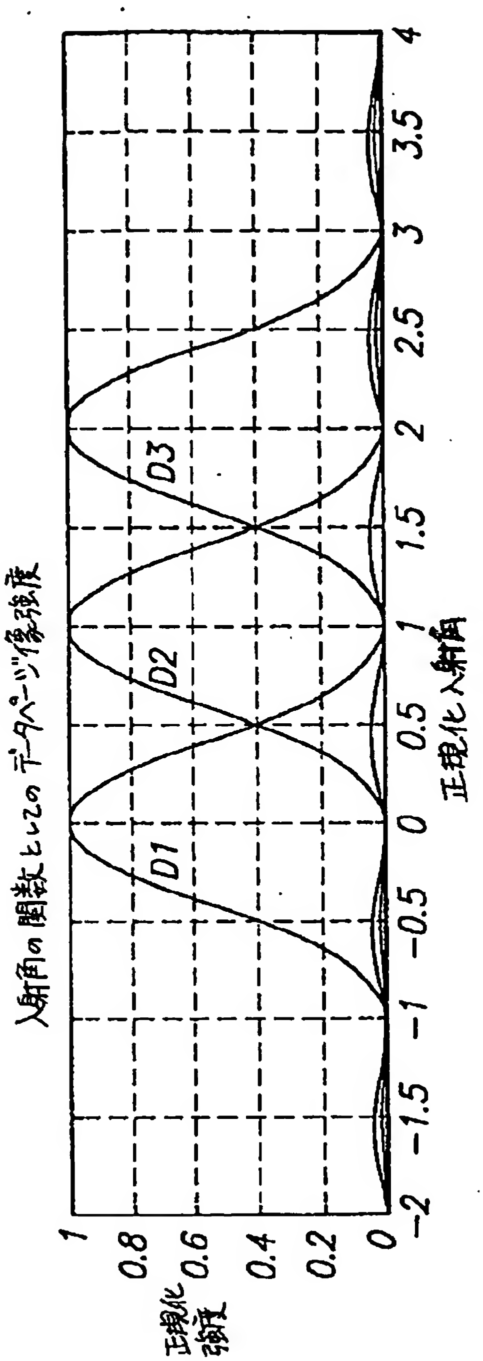

FIG. 5

[Drawing 6]

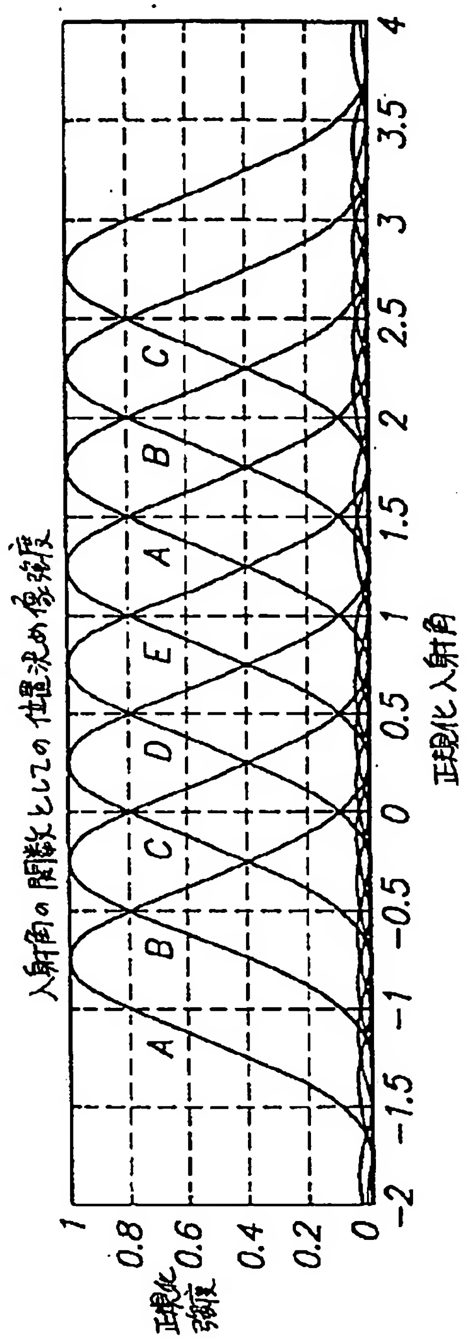

FIG. 6

[Drawing 7]

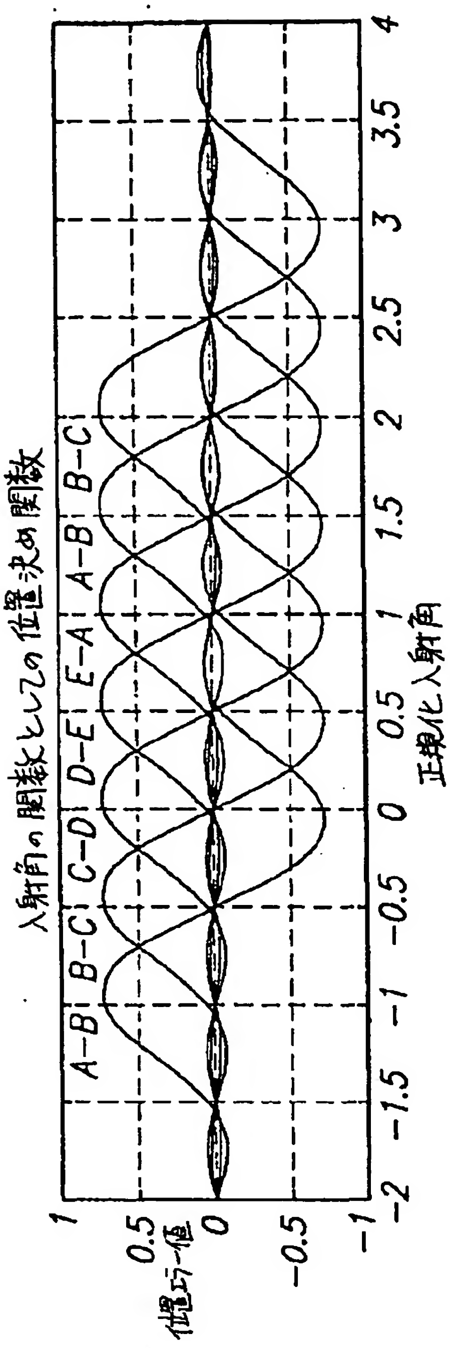

FIG. 7

[Drawing 8]

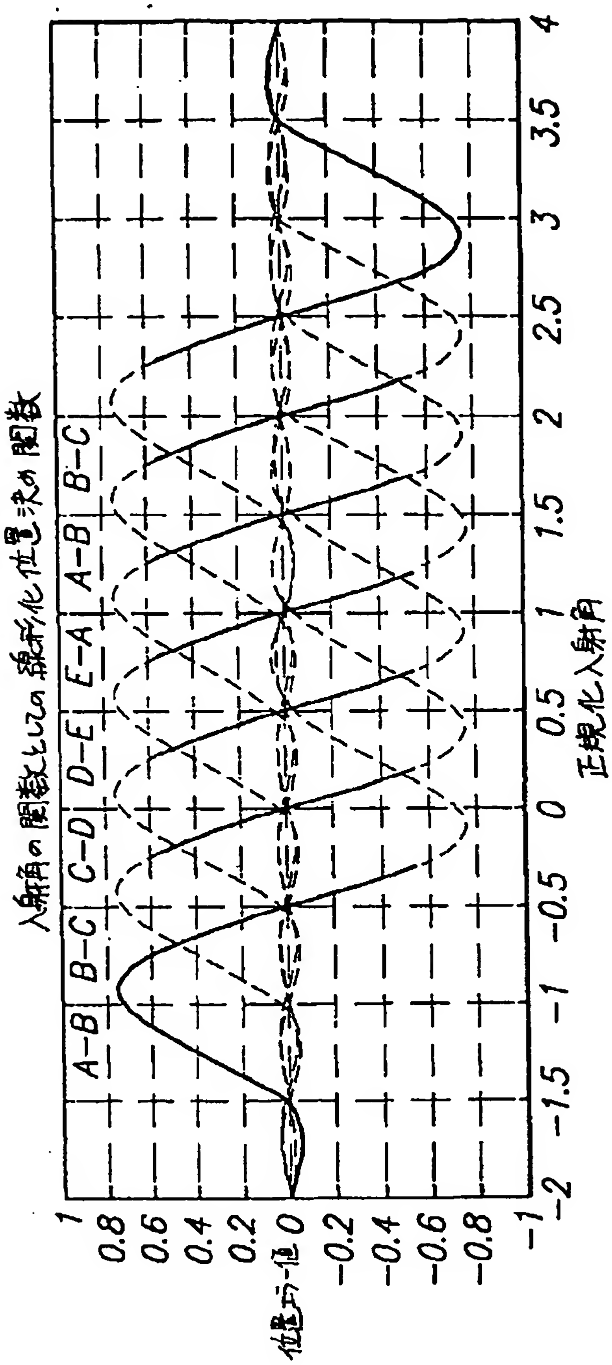

FIG. 8

[Drawing 9]

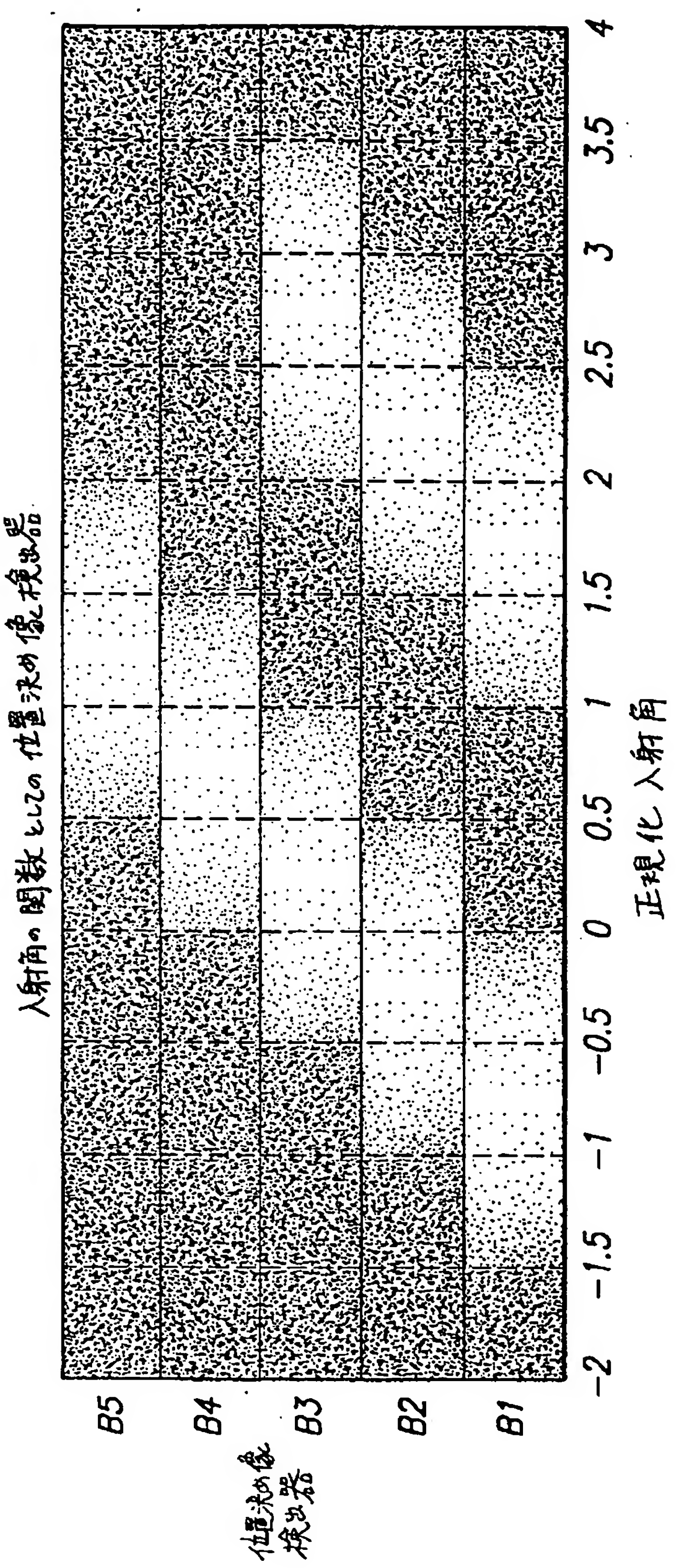

FIG. 9

[Drawing 10]

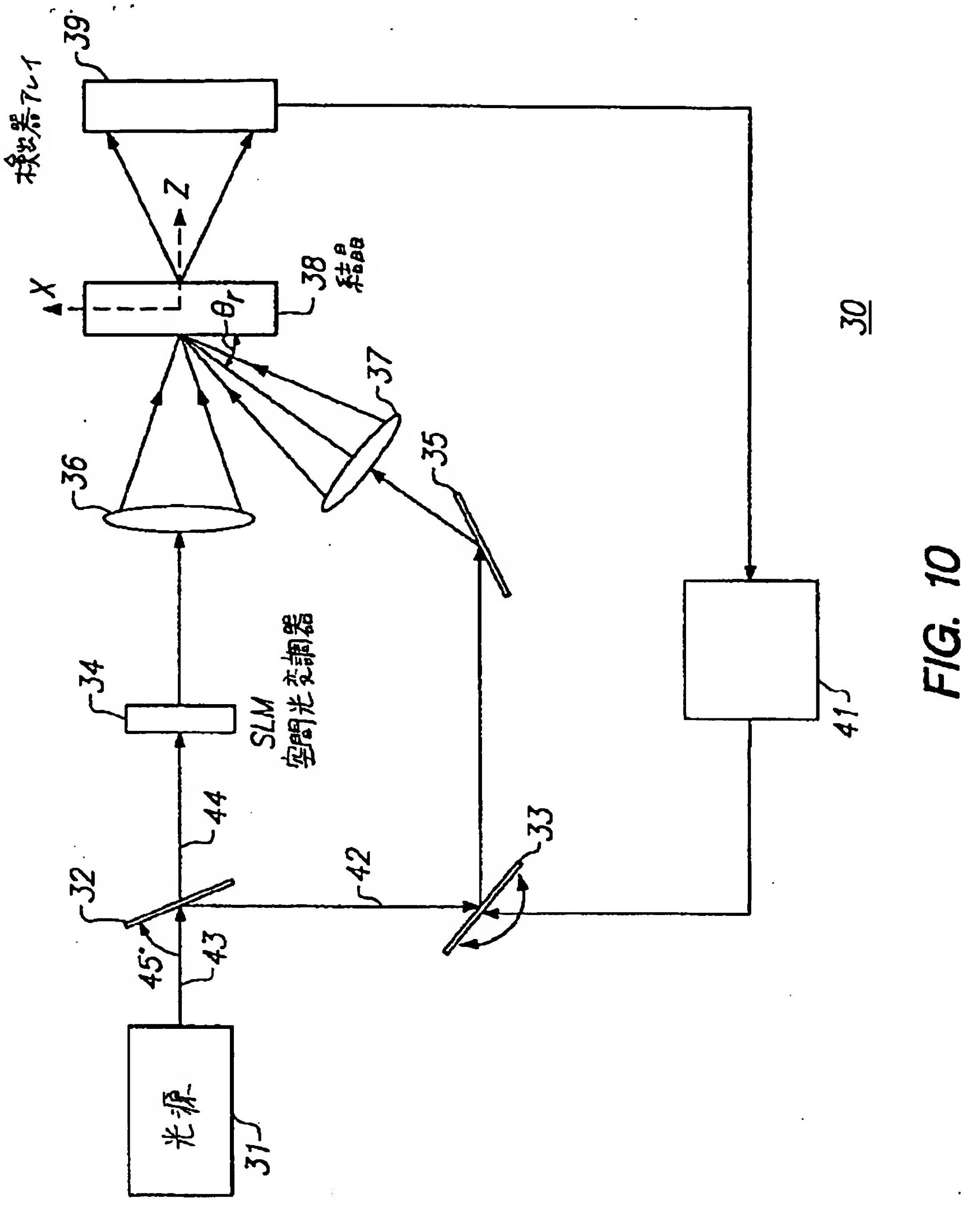
39
検出器アレイ
Z
X
38
結晶
θr
37
36
35
34
SLM
空間光変調器
44
42
32
45°
43
33
光源
31
41
30

FIG. 10

[Translation done.]